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ABSTRACT

Rationale and recommendations are presented for vocational education's response to the national energy crisis in light of present involvement and future needs. The problem is stated in terms of the need for training programs in the newer energy technologies, including those related to conservation. Federal policies are outlined, specifically the national energy goals for 1985. These are followed by a review of the status of energy technology development in four areas: solar energy, coal mining technology, nuclear energy, and other energy sources. For each area implications for vocational education are noted. A discussion of present energy-related vocational/technical curriculum development activity at both the postsecondary and secondary level includes results of a national survey of postsecondary institutions, programs, and enrollment in eight energy-related technology fields. It is concluded that there is some awareness of the problem and general methods necessary to reduce it but that the response of the vocational education sector must be one of strong leadership in the total educational community. Six specific recommendations in this regard are addressed to the new Department of Energy, to state and local advisory committees in vocational education, and to the National Institute of Education. Focus in the recommendations is on inservice training in new energy and energy conservation technologies for vocational education personnel and on curriculum development in these areas. (JT)

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THE RESPONSE OF VOCATIONAL EDUCATION TO THE NATIONAL ENERGY CRISIS

A SPECIAL REPORT OF
THE NATIONAL ADVISORY COUNCIL ON VOCATIONAL EDUCATION

DECEMBER 1977

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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December, 1977

The President

Dear Mr. President:

The National Advisory Council on Vocational Education has the honor to submit a special report on *The Response of Vocational Education to the National Energy Crisis,* in accordance with Public Law 94-482, Section 162(b) (3).

The emphasis on energy education in this new vocational education legislation makes it important that we review at the national level the problem areas of the energy crisis, and the contribution that vocational education might be expected to make.

The Council reviewed this report at its meeting on September 22 and 23, 1977, and approved the recommendations with which it concludes.

Respectfully,

John W. Thiele
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Marvin J. Feldman • Russell H. Graham • Nola Haerle • Caroline Hughes • Thomas A. Jackson • Walter K. Kerr • Virla R. Krotz
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THE RESPONSE OF VOCATIONAL EDUCATION TO THE NATIONAL ENERGY CRISIS

The Problem

Public opinion polls indicate that the American people generally do not believe that an energy crisis exists. Many vocational educators, particularly at the administrative level, are reluctant to invest in training programs in the newer energy technologies, including those related to conservation, until definite need has been established.

The lead time, however, for the development of a new postsecondary curriculum is estimated as at least three years, (Walter S. Brooking, USOE, speech presented at a National invitational conference sponsored by ERDA and AACJC, October 1976), with five years minimum for the first students to enter the labor force. Times for secondary curriculum development are comparable. Without incentive funding such curricula will not be developed.

Incorporation of newer energy concepts, techniques, and skills into existing programs requires the cooperation of the current teachers of such programs. This will not happen without strong and enlightened leadership and incentives for inservice training for change.

All indications are that the energy crisis is upon us and will remain until positive steps are taken to increase the supply by the development of additional or alternative sources of energy and to reduce the demand by energy conservation measures. Anything that is done along these lines will sooner or later impinge on vocational education. Now is the time for vocational education to begin to prepare for the emerging technologies and industries of the 1980's. The preparation which is demanded from the vocational education leadership lies primarily in the area of curriculum development and in improving existing delivery systems for cooperative vocational education and work study programs. In addition, all vocational education counselors and instructors in the energy technology and industry occupations must begin to acquire at least a minimum background of alternative energy sources and energy delivery systems. All must be prepared also to respond in a positive way to the necessity for diminishing the demand for energy. Restraint in the use of natural resources or public utilities is a concept very foreign to the average American. It has been too long a source of national pride that we are a land with an abundance of everything. We do not accommodate easily to the idea that some things are giving out and that the inevitability of the principle of "Waste not, want not" is upon us now.

Federal Policies and Programs

The establishment of a cabinet level Department of Energy and the final version of a National Energy Act based on national energy goals will have a definite impact on industrial technology in alternative energy fields. At present the national energy goals for 1985 include:

- reduction of annual growth of U.S. energy demand to less than 2 percent.
- reduction of level of oil imports to less that six million barrels per day.
- achievement of a 10 percent reduction of gasoline consumption from the 1977 level.
- insulation of 90 percent of all American homes and all new buildings
- an increase in annual coal production to at least four hundred million tons over 1976 production.
- use of solar energy in more than two and one-half million homes.

To achieve these goals federal legislation will provide:

- grants for energy inspections and installation of energy conservation equipment in schools, hospitals, and local government buildings.
- grants for solar energy research development and demonstration for farm buildings, homes, machinery, with definition of solar energy broadened to include all non-fossil fuel technologies related to agriculture.
- grants for vocational education programs in coal mining technologies and in solar and wind energy technologies.

While the actual funding levels in energy research and development are not final at this time, the following table gives the recommendations of the Science Committee for ERDA for fiscal 1978 authorizations.

Nuclear	$ 3.39 billion
Solar, wind	$ 372.3 million
Biomass	$ 21.0 million
Geothermal	$ 126.4 million
Coal	$ 512.1 million
Magnetohydrodynamics	$ 63.4 million
Oil and gas	$ 88.1 million
Conservation	$ 593.3 million
Environment and safety	$ 277.0 million

Development in Energy Technologies

Solar Energy

Solar energy, although still in the experimental stage, is predicted to become an important alternative source of energy. The Solar Industries Association has over 200 members, including 38 solar contractors. Public Law 94-482 under Title II, Vocational Education, provides funding for energy education programs. These specifically mention solar energy.

> Funds available under section 120 may also be used to make grants to postsecondary educational institutions to carry out programs for the training of individuals needed for the installation of solar energy equipment, including training necessary for the installation of glass paneled solar collectors and of wind energy generators, and for the installation of other related applications of solar energy.

Developments in solar heating/cooling technology may be expected to have a significant impact on the model energy conservation building code which is being developed by ERDA and major national building code organizations. It is estimated that if this code were adopted by all states and localities it would cut annual energy consumption in new buildings by nearly 27 percent.

The newer developments on solar energy and related energy conservation technologies will undoubtedly lead to a limited demand for professional solar engineers. An August, 1976 article in *Worklife*, "Solar Energy: Potential Powerhouse for Jobs," predicts that a strong impact will be felt by workers in the construction and home heating industry including carpenters, cement masons, electricians, plumbers, sheet metal workers, air-conditioning, heating, and refrigeration technicians, glaziers, and crane operators, as well as factory workers with assorted skills. Other professions which may feel some effects include architecture, law, sales, real estate appraisal and assessment, zoning and consumer protection. More recent information on the relationship between energy technology and the labor market can be found in *Worklife* for October, 1977

in the article "Energy War is Generating Jobs." It is pointed out that while initially the jobs associated with energy conservation were low-level, short-term, minimum wage positions, retrofit operations in the near future will involve elaborate equipment changes. In addition, new buildings designed with energy-saving equipment will require technicians in the construction and instrumentation industries. Many new companies are getting into the solar energy business and some of the Nation's top research organizations are working on solar equipment. Twenty-three States have passed some form of solar energy legislation. The National Solar Heating and Cooling Information Center in Rockville, Maryland is receiving 3,000 toll-free telephone calls and 2,000 letters weekly. The sheet metal workers union commissioned an independent study of energy developments and has concluded that a government-assisted solar energy program covering structural heating and cooling would lead to full employment in the sheet metal industry.

Wind energy for which vocational education programs are also funded can be a rich source of jobs. An FEA task force has estimated that windpower could generate 23 percent of America's electricity by 1990. A report to the New York State Legislative Commission on Energy Systems calculated that the operation and maintenance of wind systems would require two to four times as many workers as nuclear plants or coal-fired plants of the same capacity. The FEA project study foresaw 245,000 new jobs in this area. Job categories include design and systems engineers, electricians, iron workers, welders, and carpenters.

Solar energy can also be used to produce electrical energy both by the solar power plant and by the solar photovoltaic conversion system. ERDA has selected Barstow, California as the site of its first solar electric plant. *Chemical and Engineering News* for January 17, 1977 carries the following item:

> ERDA has selected a California site for its first solar energy electric power plant. A group of utility companies headed by Southern California Edison offered the Mojave Desert site to ERDA and they will operate the 10-Mw pilot plant when it is completed in 1980-81. The plant will use the so-called central receiver concept, where a field of mirrors beams solar rays at a central boiler on top of a tower. The California group will pay about $20 million for its share in the project, and ERDA will come up with another $4 million. Honeywell, Martin-Marietta, and McDonnell-Douglas are working on preliminary designs for the plant, and Boeing is developing the heliostat field.

Coal Mining Technology

A second area of federal support for energy vocational education is the field of coal mining and coal mining technology. Coal is one of the oldest of the nation's energy sources. Surpassing wood in the late 1800's, it peaked at slightly over 75% in the early 1900's. At the present time, however, it has declined to less than 25%. Many factors have contributed to the increasing use of petroleum and natural gas and the decline in the use of coal. With the prospect of increasing costs and of increasing dependence on the uncertainties of foreign imports for oil and gas, the available domestic supply of coal assumes new importance. The most serious drawbacks to increased use of coal are in the areas of mining safety and in the protection of the environment from damage both by the mining process itself and by the utilization of coal as a fuel. Public Law 94-482 recognizes the need to meet these problems by appropriate training of miners, supervisors and technicians in the field of coal mining and coal mining technology. The directions for funding in Sec. 123 are among the most detailed in the entire legislation.

ENERGY EDUCATION

> Sec. 123 (a) (1) Funds available to States under Section 120 may be used to make grants to postsecondary educational institutions to carry out programs for the training of miners, supervisors, technicians (particularly safety personnel), and environmentalists in the field of

coal mining and coal mining technology, including acquisition of equipment necessary for the conduct of such program.

(2) Grants made under this section shall be made pursuant to applications which describe with particularity a program for the training of miners, supervisors, and technicians in the field of coal mining, and coal mining technology including provision for supplementary demonstration projects or short-term seminars, which program may include such curriculums as (A) the extraction, preparation, and transportation of coal, (B) the reclamation of coal mined land, (C) the strengthening of health and safety programs for coal mine employees, (D) the disposal of coal mine wastes, and (E) the chemical and physical analysis of coal and materials, such as water and soil, that are involved in the coal mining process.

Speakers at a symposium, "The Coal Dilemma: How and Where to Use It," held in Colorado Springs, February, 1977, made various projections concerning the growth of the coal industry as a response to the energy shortage. It is estimated that the United States will have to put into operation between now and 1990 at least 210 coal mines, each with a production of 5 million tons a year. To man the mines involved, 246,000 hourly and 43,000 salaried employees will be required. The coal industry must more than double its recruitment in the next ten years since about 40 percent of the present workforce will retire during that interval.

The Federal Energy Administration, in a preliminary report of the U.S. energy situation, predicts that coal production will increase from 660 million tons in 1976 to 1 billion tons in 1985. About 710 million tons is expected to come from the eastern U.S. and the remainder from the West. The same report predicts that while the newer technologies, such as solar, geothermal, and synthetic fuels, will meet only about 1 percent of total energy needs by 1985, they could contribute as much as 11 percent by the year 2000.

Increasing coal production will affect the job market in areas other than those related to mining and mining technology. A recent Department of Transportation report said that the railroads that account for 89 percent of all coal shipped by rail were projecting a doubling of their tonnage figures by 1980. Those railroads were considering the investment of more than $1.5 billion during 1977-81 period for improving tracks, signaling, and facilities for coal movements. They also estimated an expenditure of $3.6 billion for more than 100,000 additional coal cars and nearly 2,000 coal-service locomotives during that time. There would be corresponding increases in the railroad industry work forces.

Nuclear Energy

Nuclear energy, in spite of the problems associated with it which are being currently emphasized, is predicted to play an increasingly important role in the nation's economy. The Federal Energy Agency in a recent report predicts that by 1985 the U.S. could generate 70% of its electricity from coal and nuclear power, compared with 54% today and that nuclear power alone could account for 23% of total electrical generation, compared with 9% today.

The tables below show where nuclear power stands today and what its growth rate is expected to be in comparison with that of other sources of electrical generating capability.

Where nuclear power stands today

	Number of units	Capability (megawatts)
Reactors operating	64	45,455
Construction permits	72	76,224
Limited work authorization	19	20,286
Under construction	65	74,507
Letters of intent	8	8,460
TOTAL	228	224,932

Source: Atomic Industrial Forum

Nuclear will remain the fastest growing power source

Electrical generating capability, gigawatts [a]

	1975	1976	1977	1980	1985	Average annual growth, %
Nuclear	33	43	51	78	174	18.1%
Hydro	59	59	60	65	67	1.3
Pump storage	9	10	10	13	18	7.0
Coal	183	193	204	247	321	5.8
Oil[b]	127	134	140	155	163	2.6
Gas[b]	83	64	65	59	49	-2.4
Other	1	1	1	2	6	19.7
TOTAL[c]	474	503	531	619	798	5.3%

[a]Contiguous U.S. [b]Steam, combustion turbines, and combined cycle units. [c]Columns may not total exactly because of rounding. Source: National Electric Reliability Council.

Other Energy Sources

Among the alternative energy resources which are still chiefly in the experimental stage are geothermal energy and various approaches to the utilization of ocean energy resources. These include ocean thermal energy conservation (OTEC), tides, waves, salinity gradients, currents, winds and bioconversion. The harnessing of tidal energy has been in progress in France since 1966 and in the USSR since 1969. The United States and Canada have considered tidal projects from time to time but high capital costs, engineering difficulties, environmental questions, and other problems have impeded development.

New uses for existing energy sources are exemplified in the development of electricity-powered and diesel-powered automobiles. ERDA has the responsibility of producing a demonstration fleet of 32,500 electric cars by the summer of 1978.

Vocational Education Curriculum Development

What has been the response of vocational/technical curriculum development to preparing students for future energy technologies? What can be done in those areas which are still almost totally dependent on government-subsidized research and development?

Postsecondary

A study sponsored by the American Association of Community and Junior Colleges and the Energy Research and Development Administration gives baseline data at the postsecondary level on institutions, programs and enrollments in energy-related technologies. A survey was conducted from October 1975 through January 1976 of 1,152 community colleges. The response rate was 67 percent (774 colleges). Results showed 53 colleges offering 62 programs enrolling 4,159 students. There were 24 programs in coal-mining technology, 19 in nuclear energy, 13 in petroleum technology, 4 in laser-optics, and one each in solar energy and energy conservation. Among 111 new colleges there were117 programs in planning stages characterized as informal, preliminary, or formal. Solar energy programs included one in the formal planning stage, 12 in preliminary planning, and 17 in informal planning. Of the six geothermal energy technology programs, 4 were in the informal planning stages, one in the preliminary and one in formal. There was also a variation in the geographic location of the programs and in the involvement of ERDA and of industry in both planning and implementation. The tables which follow summarize these data and are taken from the final

report of the study, *Energy-Related Technology Programs in Community and Junior Colleges: An Analysis of Existing and Planned Programs* by John R. Doggette. The report points out that some colleges which did not report existing or planned programs in the newer energy technologies have nevertheless incorporated related techniques into existing programs. One college has implemented a solar energy technology emphasis into its heating and air-conditioning program. Also, colleges which are funded to construct solar heating system facilities will be able to use these facilities as laboratories.

AACJC Survey of 1152 Colleges

Programs in Operation 1976

Energy-Related Technology	Colleges	Programs	1975 Graduates	Projected 1976 Grad
Petroleum (oil/gas)	12	13	126	143
Coal mining	17	24	153	343
Nuclear energy	18	19	83	210
Solar energy	1	1	40	35
Laser-optics	4	4	26	59
Geothermal energy	—	—	—	—
Energy (general)	—	—	—	—
Energy conservation	1	1	30	22
TOTAL	53	62	458	812

Programs in the Planning Stages 1976

Energy-Related Technologies	Colleges	Programs
Petroleum (oil/gas)	11	13
Coal mining	20	25
Nuclear energy	17	19
Solar energy	30	30
Laser-optics	8	8
Geothermal energy	6	6
Energy (general)	16	18
Energy conservation	13	13
TOTAL	121	132

Secondary

There has been no general survey of programs in energy-related technologies at the secondary level but there is evidence of some activity. *The Seventh Annual Report of the West Virginia State Advisory Council on Vocational Education* shows nine programs in mining: two each in the Mine Maintenance Cluster and in Mine Machinery Repair; and one each in Mine Hydraulics, General Mining, Mine Maintenance, and Mine Electricity. The number of students enrolled in these courses totals 457. There are also twenty-four postsecondary programs, five of which lead to the associate degree, and twenty-eight adult programs. The Fall, 1976 issue of *Bridge*, the official publication of the West Virginia Bureau of Vocational, Technical and Adult Education, features mine training as a voc-ed priority. The Marion County Cooperative Mine Training Program is operated by the county board of education which provides facilities and instructors and the mine companies (Bethlehem, Eastern, and Piltson) which provide the trainees and the facilities for on-the-job training. Instruction is in mine maintenance and includes hydraulics, mechanics, welding, and troubleshooting. In another cooperative program 1300 women received three-month classroom training in electronics, hydraulics, mechanics, welding, and blueprint reading followed by work on actual equipment, rewiring control panels, and rebuilding motors. All graduates of the program are now placed in jobs. In addition, the West Virginia Department of Education is engaged in federally funded research on the "Development of a Curriculum for Upgrading Mine Electricians in the Use of Solid State Electrical Controls." Several other states are engaged in energy-related activities. Kentucky has published a report: "Mining and Reclamation Cooperative Education Program." This describes a project involving Madisonville State Vocational-Technical School, Madisonville Community College, coal mining companies and government agencies. In Pennsylvania, federally sponsored research is in progress on "Competency-Based Curricula Development for the Mining and Related Industries."

Several LEAs that customarily involve their vocational education students in projects resulting in the building, furnishing, and sale of a house have selected plans for solar heating/cooling systems.

The U.S. Department of Agriculture and the Federal Energy Administration have jointly published a series of guides under the titles: *A Guide to Energy Savings for the Dairy Farmer; the Field Crop Producer; the Poultry Producer; the Vegetable Producer; and the Livestock Producer.* These should prove extremely helpful in the updating of curriculum materials. Another source of current data is *Energy Use in Agriculture: Now and for the Future,* published by the Council for Agricultural Science and Technology.

The six Oklahoma Vo-tech student organizations, FHA, FFA, DECA, FBLA, VICA, and OHOSA have chosen energy conservation as a joint project for the coming year.

In the March, 1977 issue of *Energy and Power,* a quarterly journal published by the National Educational Council on Energy and Power, a report is given on a series of five regional hearings. The hearings were conducted during May, 1976 by the Educational Testing Service and were directed towards the current status and future needs of in-school energy education. The NECEP report summarizes the concerns of the participants as follows:

- Energy education must develop an awareness that conservation is imperative and that it will demand a change in life style.
- There is need for direction in developing energy education curricula. Local or regional energy education goal development is a prerequisite.
- Energy education can be more effective when taught as integrated and interrelated content. (However, few participants could identify existing school organizational structures designed to implement an interdisciplinary approach to energy education.)

- Acceptance of long-range commitment to energy education will require immediate inservice teacher training programs and upgrading of preservice programs.
- Adequate funding is crucial especially for curriculum development including the production of classroom materials.

Conclusion

From the information assembled in this paper we can conclude that there is some awareness of our very serious national energy problem and of the general methods necessary to solve it: reduction of demand by conservation, and increase of supply by the development of alternative energy sources to supplement or replace gas and oil. The particular response of the vocational education sector must be one of strong leadership in the total education community. The National Advisory Council on Vocational Education, accordingly, strongly endorses the recommendations with which this report concludes.

Recommendations

1. NACVE recommends to the new Department of Energy that it fund a series of institutes and workshops for secondary and postsecondary vocational education teachers in solar, nuclear, geothermal, coal, agriculture (including biomass) energy technologies as well as in energy conservation technologies. Participants selected would not necessarily be currently teaching in energy-related programs.

   Such institutes proved highly successful in improving science education and raising the level of consciousness of the American people to the then current inadequacies of American technology at the time of the launching of the first Russian Sputnik. They were funded by the NSF and AEC and contributed largely to giving the United States the most advanced space technology in the world.

2. NACVE recommends that the SACVEs, in their participation in State Plan formulation, urge the inclusion of objectives directed toward updating existing energy technology curricula and development of new programs. Objectives related to professional development of teachers, guidance counselors, and administrators should also be examined in the light of energy-related criteria. Annual evaluation reports should give special emphasis to the evaluation of outcomes of these objectives.

3. NACVE recommends that the Commissioner, in programs identified as of national significance in PL 94-482 Sec. 171 and Sec. 172, give high priority to program improvement in energy-related technologies and to leadership development programs for vocational education personnel in these technologies.

4. NACVE recommends that NIE survey a representative sample of school districts to identify and disseminate those consumer and homemaking programs which are funded under PL 94-482, Sec. 150, which show strong energy conservation components, stressing both scientific orientation and economic principles.

5. NACVE recommends that SACVEs encourage local advisory councils in their states to update surveys of local industries in order to locate opportunities for cooperative programs in energy-related technologies.

6. NACVE recommends that state and local advisory councils recruit or suggest for membership workers in energy-related technologies.

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